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AUTHOR Plumb, Geri; And Others
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ABSTRACT

A structured tutoring program was successfully used with 500 low-achieving students in Boise (Idaho) Title I elementary schools. Students in grades 1 through 3 were tutored by able fifth and sixth graders who were trained and supervised; students in grades 4 through 6 were tutored by adult aides. The tutoring program used structured sequential mathematics materials, frequent mastery checks, review, and positive reinforcement. Students were tutored for a period of 3.5 months, for an average of fifty-seven 20-minute sessions. At all grade levels, grade equivalent gains exceeded a full year's growth. Pre- and posttest measures showed significant ($p < .001$) gains in addition, subtraction, and multiplication. (Author/SD)

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CROSS-AGE TUTORING IN ELEMENTARY BASIC MATH

DR. GERI PLUMB
BOISE PUBLIC SCHOOLS

DR. ANNE TERRILL
BOISE PUBLIC SCHOOLS

MS. DOLORES BURROW
BOISE PUBLIC SCHOOLS

SESSION #20.02
A.E.R.A.

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CROSS-AGE TUTORING IN ELEMENTARY BASIC MATH (EVA)

Dr. Geri Plumb, Boise Public Schools

Dr. Anne Terrill, Boise Public Schools

Ms. Dolores Burrow, Boise Public Schools

Abstract

Fifth and sixth grade students, trained as tutors and monitored by adult managers, spent not more than 20 minutes per day with 337 under-achieving learners in grades 1 through 3. Trained adults tutored 209 students in grades 4 through 6. Structured, sequential math materials utilizing frequent mastery checks and review coupled with positive reinforcement strategies yielded significant gains ($p < .001$) in addition, subtraction, and multiplication across all grade levels. Students were tutored for an average of 57 sessions, approximately 3½ months of the school year. At all grade levels, grade equivalent gains exceeded a full year's growth.

CROSS-AGE TUTORING IN ELEMENTARY BASIC MATH

Dr. Geri Plumb
Boise Public Schools

Dr. Anne Terrill
Boise Public Schools

Ms. Dolores Burrow
Boise Public Schools

SUMMARY

Objectives

The Structured Tutoring Program in Math is perhaps a major breakthrough in maximizing human resources in a school setting to assist the below average student. Fifth and sixth grade students are trained as tutors, and while monitored by adult managers, spend not more than twenty minutes per day with first, second, and third grade learners. Adult aides utilizing the same structured materials tutor below average fifth and sixth grade students. The major objective of the program is to effect grade equivalent gains in math which exceed that expected for the low achieving student.

Theoretical Framework and Materials

The Structured Tutoring Program as developed by Grant Harrison[1] (1971) utilizes many of the well established tenets of Educational Psychology.

Positive Reinforcement

Of key importance to the success of the materials in increasing basic math skills is a heavy dependence on positive reinforce-

[1] G. Harrison, Structured Tutoring (Provo, Utah: Department of Instructional Research & Development, Division of Instructional Services, Brigham Young University Press, 1971)

ment techniques throughout the tutoring experience. Student learners are rewarded and receive immediate feedback for small steps in acquisition through a variety of methods, ranging from student tutor verbal approval to notices sent to parents, teachers and principals. Punishment, censure, reprimand and criticism are strictly avoided in tutor training and constant monitoring of tutor behavior assures its absence.

Task Analysis

The content area of Basic Math has been analyzed by Dr. Harrison into thirteen categories which have been listed sequentially from Basic addition and subtraction through multiple digit multiplication, each step being subsumed under the following steps.

Materials Presented in Small Steps

A diagnostic pretest places the student within the sequenced sub-areas of math. Each step logically follows the one before and is structured into small enough units that the student has a high probability of success.

Built-in Repetition

The low-achieving student is given repetition based on his/her individual need as defined by attainment during any particular tutoring session through the use of the following: utilization of flashcards; lessons which incorporate previous lessons; retracing of steps when forgetting occurs; and frequent mastery and review checks.

One-To-One Tutoring

Individual help enables specific strengths and weaknesses of the student learner to be closely diagnosed and the rate of acquision to be carefully monitored. Affectively, the low-achieving student profits from individual attention which is of a positive nature and which is contrary to the frequent criticism and failure met in the regular classroom.

Complete Data for Evaluation Purposes

Extensive records are maintained on pretest, prescription, daily attainment, mastery dates and posttest scores for the purposes of monitoring individual progress and evaluating the effectiveness of the program as a whole.

Data Source

In the 1975-76 school year, approximately 500 students in grades 1 through 6 in 14 Title I schools were tutored in Basic Math in the Boise Public School System. In general, students in grades 1 through 3 were tutored by older students serving as tutors while students in grades 4 through 6 were tutored by adult tutor aides.

All student learners were given a pre-post administration of the individually administered Key Math Test to determine grade level equivalency. The students were placed in the tutoring sequence on the basis of scores on the Harrison criterion-referenced tests in math.

Results and Conclusions

Table I presents the Key Math data for all grade levels. It should

be noted that because of the remedial nature of the tutoring program grades 1 and 2 received tutoring in addition and subtraction with little or no tutoring in multiplication. At all grade levels, raw score gains were made, and in each case, grade equivalent gains exceeded one year's growth. Of special importance is the fact that the students made these sizeable gains after being tutored an average of only 57 twenty minute sessions.

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Insert Table I about here

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Table II presents the test of significance for the pre-post Key Math data. Across all students, gains significant beyond the .001 level of significance were made on the addition, subtraction and multiplication subscales.

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Insert Table II about here

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Figures 1, 2, and 3 indicate by grade level the pre and post raw scores on Addition, Subtraction and Multiplication Facts subscales on the Harrison criterion-referenced diagnostic test.

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Insert Figures 1, 2, and 3 about here

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Tables III and IV present tests of significance for the pre-post data on all Harrison diagnostic subscales. On all subscales, the results indicated that gains were significant beyond the .001 level of significance.

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Insert Tables III and IV about here

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Educational Importance of the Study

The progressive, cumulative deficit of the low-achieving child which widens with each year of schooling must not only be stopped, but must be quickly reversed. Remediation methods must be sought which accelerate acquisition so that the child quickly approximates grade level performance. The Structured Tutorial Program in math is such a remedial method. In this program students were tutored an average of 57 sessions. If vacations and absences are included, these sessions occur in approximately 3½ months of the 9 month school year. An average grade equivalent gain of one year, in 3½ months of twenty minute sessions per day, represents remarkable acceleration in the acquisition of basic math skills.

The cost effectiveness of cross-age tutoring cannot be overlooked. Student tutors may serve large numbers of student learners with relatively small expenditures involving only materials and adult supervision. In addition, both parents and teachers have testified, in opinion questionnaires, that social and academic benefits have accrued to the

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Insert Tables V and VI about here

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student tutors, as well as those students who were tutored. The structured Tutorial Program necessitates total school cooperation and effort and yields positive outcomes for all participants.

TABLE I

Key Math test - Addition, Subtraction, Multiplication - and Total Raw Scores

SUBSCALES	Score	Grade 1 N=92 Mean	SD	Grade 2 N=136 Mean	SD	Grade 3 N=109 Mean	SD	Grade 4 N=88 Mean	SD	Grade 5 N=50 Mean	SD	Grade 6 N=71 Mean	SD
Addition	Pre	3.05	1.58	4.99	1.55	6.64	1.75	9.10	3.54	10.22	2.33	10.49	2.43
	Post	5.72	1.17	8.22	2.05	9.76	2.11	11.26	5.62	13.10	10.87	11.97	1.43
	Gain	2.71	1.58	3.46	2.15	3.21	2.21	2.21	1.85	2.06	1.79	2.25	2.05
Subtraction	Pre	2.95	1.44	2.28	1.33	5.34	1.28	7.01	5.42	8.64	6.97	8.26	1.95
	Post	5.18	1.15	6.51	1.36	8.15	2.13	8.92	3.03	10.52	2.73	10.32	1.92
	Gain	2.28	1.56	2.42	1.56	2.87	2.24	2.67	1.83	2.64	2.08	2.54	2.13
Multiplication	Pre	.36	.58	.86	.96	1.67	1.38	3.78	4.90	4.84	1.82	5.87	1.97
	Post	1.01	.90	2.13	5.39	4.49	1.69	6.01	1.94	7.38	2.12	8.00	1.82
	Gain	.74	.80	1.11	1.12	2.91	1.86	2.83	2.01	2.81	2.05	2.54	1.99
Total	Pre	39.97	13.68	65.18	49.35	81.40	13.74	101.51	15.88	121.47	17.76	131.93	18.99
	Post	67.96	11.86	132.40	170.87	112.40	19.84	130.65	16.11	143.34	15.93	158.08	18.18
	Gain	27.38	13.37	31.26	15.75	31.62	15.33	30.41	13.40	24.58	16.55	27.68	17.11
Grade Equivalent	Pre	1.19	.57	1.95	.56	2.63	.44	3.33	.63	4.04	.68	4.48	.82
	Post	2.22	.40	2.93	.73	3.53	.97	4.04	1.20	4.43	1.58	5.93	1.18
	Gain	1.07	.79	1.04	.50	1.14	.72	1.18	.50	1.12	.72	1.78	1.40

TABLE 11

Key Math Test

Addition, Subtraction and Multiplication

Tests of Significance

SUBSCALES	N	Mean Pre	Mean Post	Mean Gain	t
Addition	545	6.77	9.59	2.83	15.24*
Subtraction	545	5.54	7.86	2.32	15.51*
Multiplication	544	2.28	4.28	2.00	14.46*

* the results are significant beyond the .001 level of significance

FIGURE 1

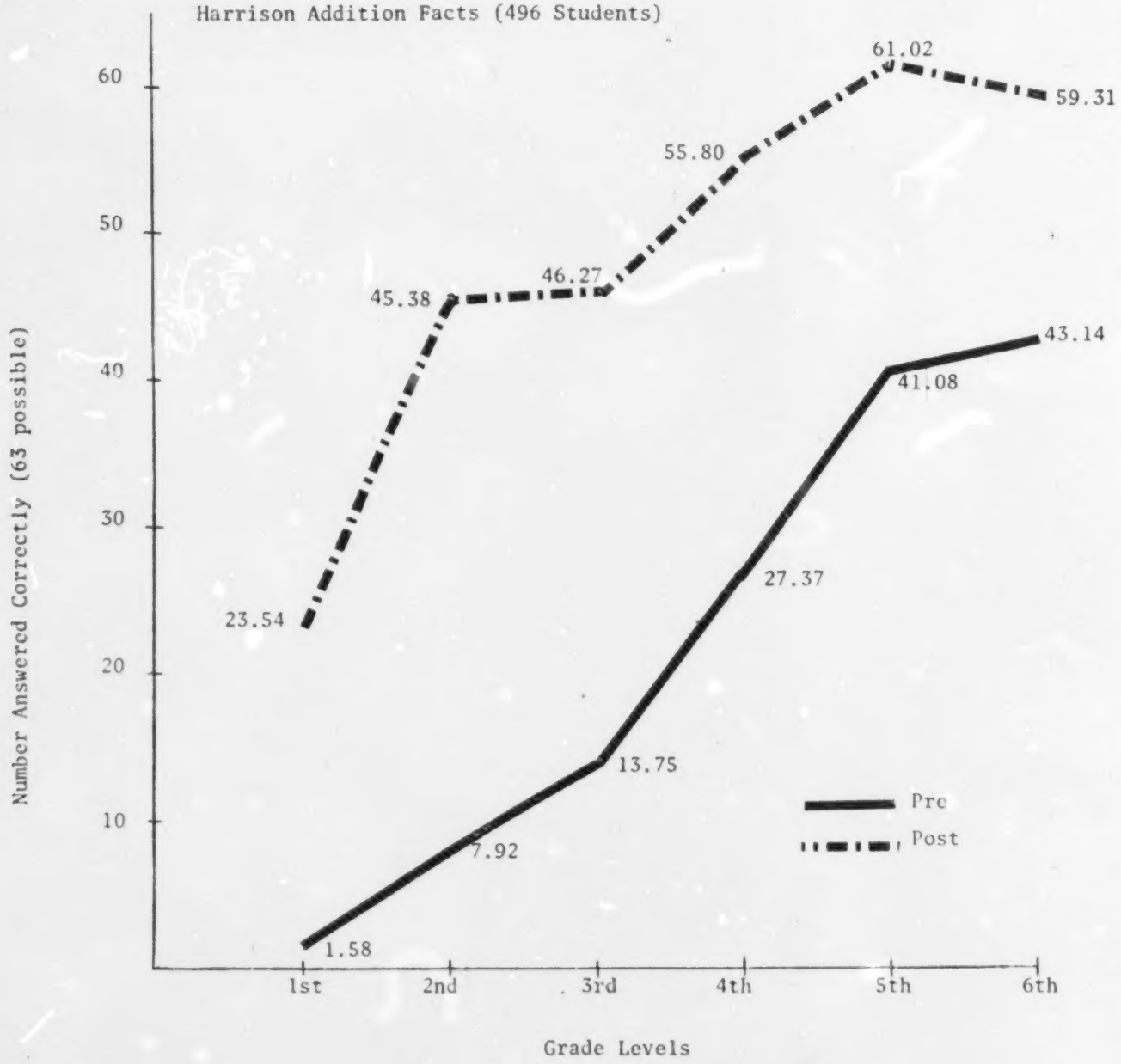
Harrison Addition Facts (496 Students)
Number Answered Correctly (63 possible)
60
50
40
30
20
10
61.02
59.31
55.80
46.27
45.38
43.14
41.08
27.37
23.54
13.75
7.92
1.58
Pre
Post
1st
2nd
3rd
4th
5th
6th
Grade Levels

FIGURE 2

Harrison Subtraction Facts (495 Students)

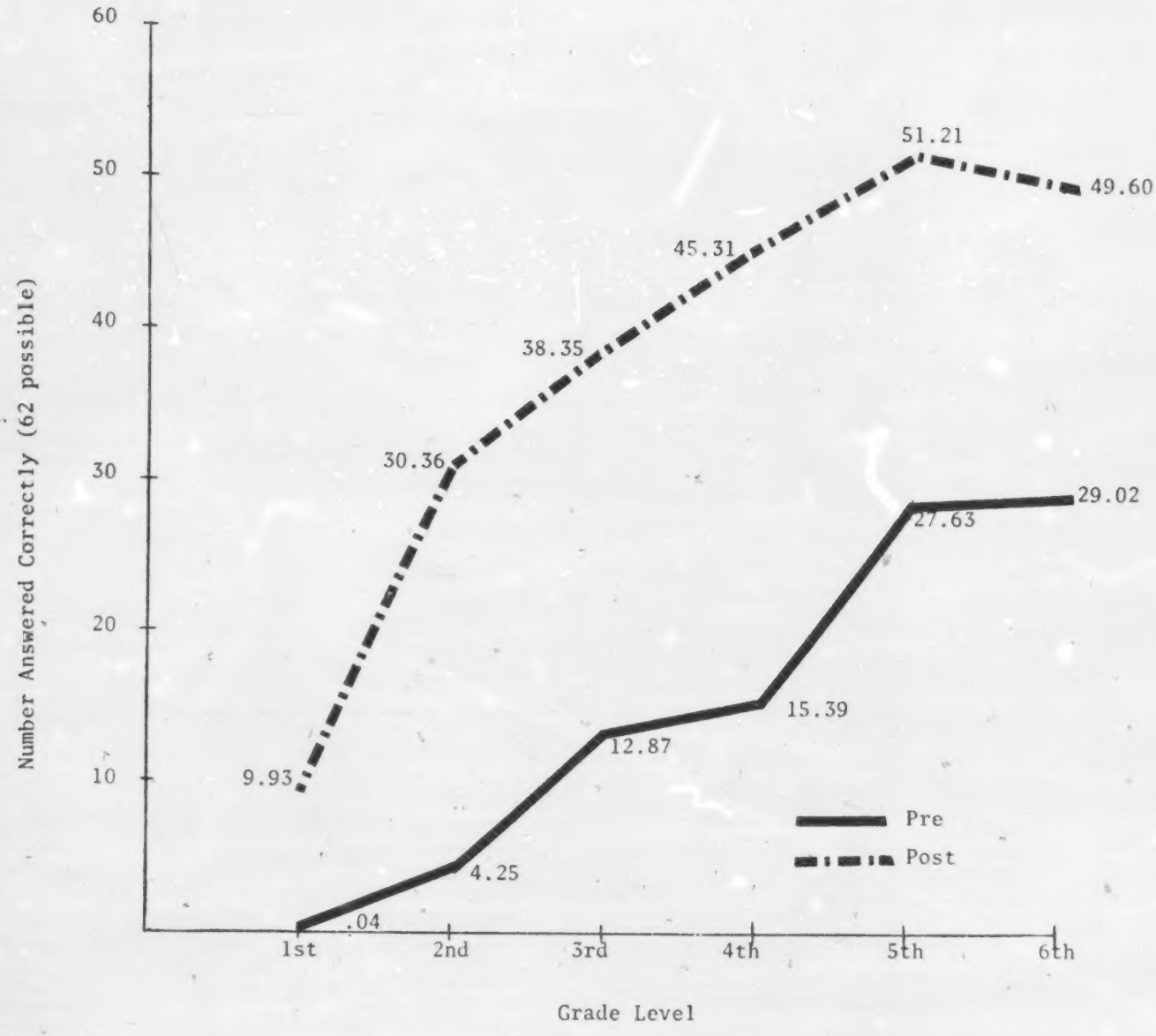

FIGURE 3

Harrison Multiplication Facts (493 Students)

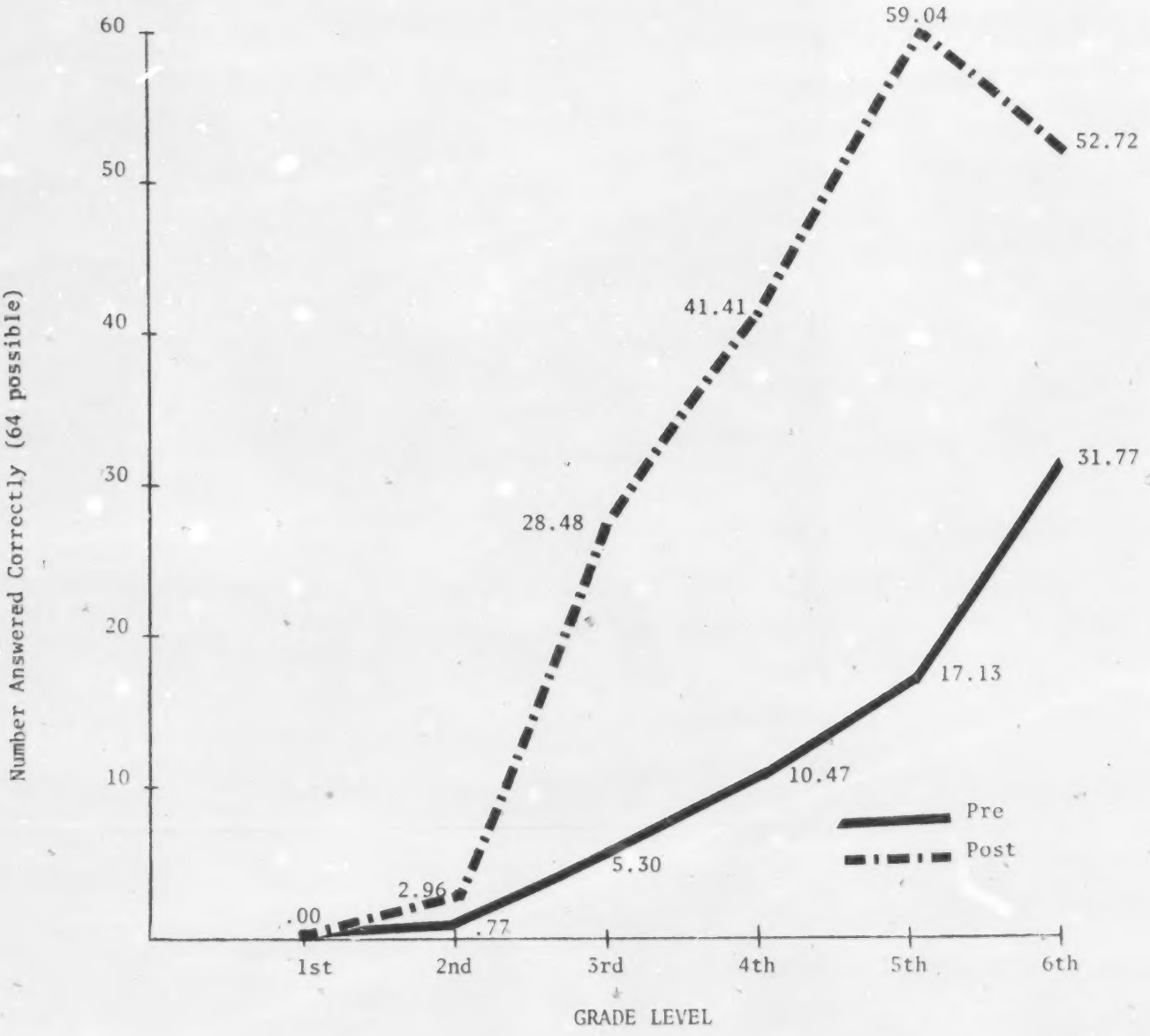

TABLE III

Harrison Math Test
Addition and Subtraction Subscales
Tests of Significance

SUBSCALES	N	Mean Pre	Mean Post	Mean Gain	t
Basic Addition	513	4.79	5.68	.89	11.12*
Basic Subtraction	512	4.52	5.66	1.14	12.72*
Addition & Subtraction	510	7.21	9.48	2.27	10.97*
Simple Addition & Subtraction	493	6.02	9.05	3.03	10.81*
Complex Addition	485	1.72	3.34	1.62	17.09*
Complex Subtraction	482	1.06	2.88	1.82	17.00*
Complex Addition & Subtraction	474	2.14	5.66	3.53	15.98*
Addition Facts	496	15.59	46.99	27.40	32.06*
Subtraction Facts	495	12.16	35.39	23.24	29.93*

* the results are significant beyond the .001 level of significance

TABLE IV

Harrison Math Test
Multiplication Subscales*
Tests of Significance

SUBSCALES	N	Mean Pre	Mean Post	Mean Gain	t
Simple Multiplication	479	1.37	2.85	1.48	15.06**
Complex Single Digit	477	.83	2.08	1.25	15.01**
Multiple Digit	488	.17	.87	.70	9.78**
Multiplication Facts	493	8.90	25.09	16.11	17.51**

* Students in grades one to three were not tutored in multiplication but are included in these analyses.

** The results are significant beyond the .001 level of significance

TABLE V

THE INDEPENDENT SCHOOL DISTRICT OF BOISE CITY

ADMINISTRATIVE OFFICES • 1207 FORT ST. • BOISE, IDAHO 83702

April 15, 1976

QUESTIONNAIRE FOR PARENTS OF STUDENT TUTORS FOR MATH

Earlier this year, as you know, your child was selected to participate in our tutoring program as a student tutor. We would greatly appreciate knowing how you feel about the program, as it may effect your child.

1. *Did your child seem pleased to be selected as a tutor?*

   99% *YES* 1% *NO*

2. *Does your child seem to feel a sense of responsibility for the child he/she is tutoring?*

   95% *YES* 2% *NO* 3% Don't Know

3. *Do you feel that, as a result of tutoring, your child is more understanding of:*

   . . . other children's learning problems?

   94% *YES* 3% *NO* 3% Don't Know

   . . . children who are younger?

   93% *YES* 3% *NO* 4% Don't Know

4. *Some people feel that tutoring helps the student tutor further develop their academic skills. To what extent do you think being a tutor has helped your child?*

   15% *NO CHANGE* 67% *HELPED* 17% *HELPED ALOT* 1% Don't Know

5. *Some people feel that tutoring helps the student tutor further develop their social skills. To what extent do you think being a tutor has helped your child?*

   10% *NO CHANGE* 68% *HELPED* 21% *HELPED ALOT* 1% Don't Know

6. *Do you have any further comments about the tutoring program?*

   "we thank you for giving her a chance to help others". "He has learned more about math by tutoring others". "I would like to hear if the tutored students gained". " --- Program is very worthwhile for all students".

Please have your child return this form to his/her tutor manager as soon as possible. Thank you for your time!

The results are based on responses from 136 parents. (49% return)

Child's Name *School*

TABLE VI

THE INDEPENDENT SCHOOL DISTRICT OF BOISE CITY

ADMINISTRATIVE OFFICES • 1207 FORT ST. • BOISE, IDAHO 83702

April 15, 1976

QUESTIONNAIRE FOR PARENTS OF CHILDREN BEING TUTORED IN MATH

This year, as you know, your child has been participating in our Structured Tutoring Program in math. We are interested in your opinion about your child's progress. Would you please take a moment from your busy day to respond to the following questions.

1. *Do you think your child was glad to have extra help in math?*

   97% *YES* 2% *NO* 1% Don't Know

2. *Does your child have a more positive attitude toward the subject of math since he/she has been in the tutoring program?*

   92% *YES* 5% *NO* 3% Don't Know

3. *Do you think that tutoring has helped your child to do better in math?*

   97% *YES* 2% *NO* 1% Don't Know

4. *Do you have any further comments about the tutoring program?*

   "He loves the subject now, thank you". "What can we do at home and during the summer?" "Glad the help was available." "I am worried about time out of class". "We appreciate the extra help". "He is more comfortable working in math".

Thank you, and please have your child return this form as soon as possible to his/her tutor.

The results are based on the responses of 290 parents. (41% return.)

Child's Name *School*